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ABSTRACT

Examined were the effects of number of stimuli and of two different stimulus modalities on the discrimination learning of 17 autistic children (mean age 57 months). Discrimination training was carried out in three groups with varied light and sound stimuli. Among findings was that mental age was negatively correlated with trials to criterion and positively correlated with response rate. (CL)

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The Effects of Number of Stimuli on Rate of Discrimination Learning in Autistic Children[1]

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The literature on autism and childhood schizophrenia contains many descriptions of perceptual and cognitive processing problems. It has been hypothesized that these problems are specific to the syndromes (e.g., Goldfarb, 1964; Hermelin and O'Connor, 1970; Ornitz and Ritvo, 1968; Schopler, 1966). Several studies have shown that autistic children have particular difficulty in responding appropriately when more than one cue is presented simultaneously (e.g., Koegel and Wilhelm, 1976; Lovaas and Schreibman, 1971; Koegel and Rincover, 1976). The results of these studies have generally been explained in terms of selective attention theory. However, learning and sensory-perceptual processing deficits have not been adequately separated.

The present experiment was designed to examine the effects of number of stimuli on discrimination learning in autistic children. In addition, discrimination learning in two different stimulus modalities was compared in an attempt to ascertain if autistic children demonstrate specific perceptual processing difficulties.

Method

Subjects

Subjects were 20 autistic children and one normal child selected from the inpatient population of the UCLA, Neuropsychiatric Institute. All autistic children met the criteria for the diagnosis of autism described by Ornitz and Ritvo (1968) and were independently diagnosed by two child psychiatrists. The mean chronological age of the subjects was 57 months while the mean mental age and IQ scores obtained on the Merrill-Palmer Preschool Performance Test were 37 months and 67 respectively.

Apparatus

The experiment was conducted in a dimly lit (40-watt bulb) room (3m x 3m). Each subject was seated in front of a desk containing stimuli, reinforcement dispenser and manipulandum mounted on three adjacent BRS-LVE human test panels. The subject's face was approximately .2 m from the stimulus panel. One stimulus, the light, was a 7 1/2 watt lamp which produced approximately 1 foot-candle of illumination at the subject's eye position. The other stimulus, a tone, was provided via a .07m speaker positioned .05m below the light stimulus. The tone stimulus brought the total room noise to approximately 66 db. On the right side of the stimulus panel a BRS/LVE Human Test lever which required 40 grams of force to operate was mounted. Reinforcement was delivered from a BRS/LVE M & M dispenser on the left side of the stimulus panel.

Procedure

Each subject was administered the procedure individually. During the first sessions, subjects were trained to lever-press for M & M candies using the method of successive approximations (cf., Frankel, Freeman, Ritvo, Chikami and Carr, 1976, for a complete description of the procedure). Initially, subjects were reinforced on a continuous reinforcement schedule which was gradually increased to a fixed-ratio six (FR-6) within the first session. During all subsequent sessions, subjects were reinforced on the FR-6 schedule.

After the lever-press training session each subject was assigned to one of three groups for discrimination training. The groups were matched on mental age obtained on the Merrill Palmer Preschool Performance Test. Two subjects were discontinued because of motivational problems and two were discharged prior to completing the experiment. This brought the total number of subjects to 17. For Group 1 (4, Ss), light-on plus tone-on was the S^D and

light-off, tone-off the S^{Δ}; for Group 2 (6 Ss), light-on was the S^{D} and light-off the S^{Δ}; and for Group 3, (7 Ss) tone-on was the S^{D} and tone-off, the S^{Δ}. Discrimination training was the same for all groups. Specifically, during S^{D}, S received candy on an FR-6 schedule, while during S^{Δ} lever-pressing did not result in reinforcement, i.e., extinction. The one-minute S^{D} intervals alternated with variable interval 30-second extinction intervals. A session consisted of 10 alternations of S^{D} and S^{Δ}, i.e., 10 trials. Each subject was trained to a criterion of 90% discrimination or for a total of 20 sessions (or 200 trials).

After the Ss in Groups 2 and 3 reached criteria, they were switched to the opposite stimulus condition (e.g., S^{D} for Group 2 became Tone while S^{D} for Group 3 became Light) and exposed to these stimulus conditions until they reached criterion (90% discrimination) or for a total of 20 sessions. In addition, after reaching criterion on each of the stimuli individually, 4 of the Ss were exposed to the combined stimulus condition, i.e., light plus tone.

Results

There were no differences among the groups in mental age scores. However, independent of stimulus group, mental age was negatively correlated ($r = -.75$, $N = 17$) with trials to criterion and positively correlated ($r = +.66$; $N = 17$) with response rate. The subjects with the higher mental ages took fewer trials to reach criterion and had the higher response rates. It should be noted that the two subjects that had to be discarded for motivational reasons, i.e., because their response rates were too low, both had mental ages below 18 months.

There was a significant difference among the three groups in the number of Ss who reached criteria ($X^2 = 9.95$; $df = 2$; $p < .01$). A larger percentage

of Ss in the tone-off condition failed to reach criteria. When the Ss who reached criteria were compared to those who did not reach criteria in this condition, there was a significant difference in mental ages ($t = 5.19$; $df = 5$; $p < .01$). The Ss with the higher mental ages were the ones who reached criteria. Thus, it would appear that for some reason the tone condition was more difficult to learn.

For the Ss who reached criteria, there was a significant difference among the groups in number of trials to criteria ($F = 7.77$; $df = 2, 9$; $p < .025$). Learning as measured by trials to criterion was more rapid to the single than to the compound stimulus. Examination of the transfer data revealed that there were no savings in learning as measured by trials to criterion. Furthermore, fewer subjects who had reached criteria in the light condition did so when tone was the S^D.

When the Ss who learned this discrimination for each stimulus alone were exposed to the two stimuli simultaneously, rate of responding for 3 of the 4 was greater than to either stimulus alone. This finding is preliminary but warrants follow-up.

If the data analysis stopped here, it would seem that autistic children do in fact learn slower to compound than to single stimuli. However, this conclusion would be premature. A further analysis of the data revealed that with other measures of learning there were no significant differences among the groups. In addition to the trials to criterion measure, two additional measures of learning were computed---learning rate and response rate pattern type.

Learning rate was computed individually for each subject using a regression analysis on S^D and S^Δ rates. When the slope of the S^Δ response curve is

subtracted from the slope of the S^D response curve; the result is the learning rate or a quantitative measure of discrimination learning.

A third measure of learning involved classifying each subject's curve according to the way S^D and S^Δ responding changed over sessions. Table 1 shows the theoretical possibilities of the relationship between S^D and S^Δ responses in discrimination learning. For example, in Type 1 learning the response rate in S^D remains the same over sessions while S^Δ response rate decreases; in Type 2, S^D responses increase and S^Δ responses remain unchanged; in Type 3, S^D responses increase while S^Δ responses decreases. Type 1, 2, and 3 represent three discrimination learning patterns, i.e., the ratio of S^D to S^Δ responses are changing. In Type 4-7, represented in Figure 1, learning is more difficult to assess. For example, in Type 4 learning, both S^D and S^Δ responses are decreasing. Depending upon initial level of responding, they may decrease at different rates and thus it would appear that the subject is learning. However, close examination would reveal that discrimination learning may not really occur. Motivational problems would have to be ruled out before it would be possible to talk about learning. In addition, if S^D responding was initially at a higher level than S^Δ responding, it would be possible to get apparent learning, i.e., subject reaches criteria when in fact no real learning occurred. Traditionally, in discrimination learning experiments when Ss reach a specified criteria, e.g., ratio of S^D to S^Δ responses or number of trials, discrimination learning is considered to have occurred and the procedure is discontinued. However, in Type 4 learning, this may not be the correct procedure. Since responses in S^D and S^Δ are both decreasing, the S may have a motivational problem that would become more apparent if further data were obtained. The same type of interpretation applies to Type 5-7. When S^D and S^Δ responses are changing in these pattenrs as with Type 4, it is likely

that discrimination learning is not occurring and other explanations for the Ss performance must be looked for.

In order to plot the pattern of responding and thus determine which type of change in S^D and S^Δ responses a subject is exhibiting, it is first necessary to perform regression analyses on S^D and S^Δ responses over sessions and determine if changes are statistically significant. The third measure of learning utilized in this study was obtained individually for each subject by this method.

In Table 2, the number of subjects who learned in each of the three groups is shown as a function of the measure of learning used. When the slope measure is used as an adjunct to the trials to criterion measure, then there are no differences among the groups in the number of Ss who reach criteria or the number of trials to criteria.

The patterning of response rate of the nonlearners were also examined. Table 2 shows that some of the nonlearners might have learned if there had notbeen an arbitrary cut-off point, i.e., 20 sessions. The response pattern of Ss who were classified as nonlearners were all changing in a non-linear manner.

There were no differences in learning rates among the groups and learning rate was not linearly related to either mental age or trials to criterion. More subjects are needed however, before these results can be considered definitive.

Discussion

The results of the present study are preliminary and at best inconclusive. However, our study clearly indicates the problems inherent in attempts to measure discrimination learning. Different measures yield different results and will

lead to different conclusions.

As is evident from these results, trials to criterion alone is not an adequate measure of learning and results can become an artifact of an arbitrary cut-off point. Only when trials to criterion is used in conjunction with the other measures disucssed here, can meaningful data on rate of learning be obtained.

The data reported on the relationships between mental age and response rate and mental age and trials to criterion are consistent with findings in other populations (Hale and Morgan, 1973). Learning in autistic children does appear to follow an orderly sequence. However, further research has to focus on how this learning occurs in autistic children and whether or not learning is linear. The data on the tone-on, tone-off condition are also consistent with that from research on stimulus preference in autistic children (O'Connor, 1971) and developmental literature.

It has been hypothesized that autistic children have faulty inhibitory mechanisms (Ornitz, 1973). It would be of interest to investigate rates of inhibitory responding in autistics. With the analysis of learning proposed here, it is now possible to do this. In addition, it is now posssible using the S^D and S^Δ slopes to examine the excitatory and inhibitory effects of different stimuli on the operant behavior of autistic children and to compare these effects to those obtained with other populations. For example, some of our preliminary data indicate that the excitatory effects of independent stimuli may summate when the stimuli are presented simultaneously, a common finding in the animal literature.

In summary, it is only these types of micro-analyses of data that will yield further information on whether autistic children do indeed possess specific sensory deficits and perceptual processing difficulties which interfere with

learning. This type of research would also be of tremendous practical significance because of the commonly held "folklore" belief that autistic children require special teaching techniques since they do not learn in the same manner as other developmentally disabled children.

TABLE 1

Theoretical, Response Patterns for Discrimination Learning

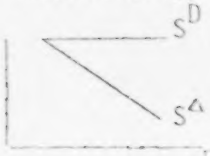
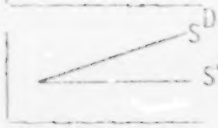
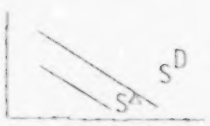
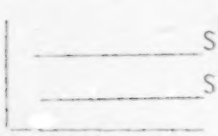
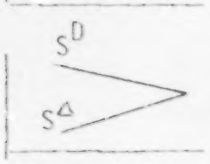
1.		S^D Responses remain unchanged S^Δ Responses decrease
2.		S^D Responses increase S^Δ Responses remain unchanged
3.		S^D Responses increase S^Δ Responses decrease
4.		S^D Responses decrease S^Δ Responses decrease
5.		S^D Responses increase S^Δ Responses increase
6.		S^D Responses remain unchanged S^Δ Responses remain unchanged
7.		S^D Responses remain unchanged S^Δ Responses increase

TABLE 2

Prediction of Number of Subjects Run Each Group as a Function of Three Different Measures of Learning

	Light and Tone		Light		Tone	
	Learners	Non-Learners	Learners	Non-Learners	Learners	Non-Learners
Trials to Criterion	3[2]	1	5[2]	1	4	3
Trials to Criterion Plus Changes in Slope	2	2	3	3	2[1]	3
Patterning	3[2]	1	5[2]	1	4	1

[1]Slopes could not be computed on two subjects because they reached criterion in 2 trials or less.

[2]Note even though the number of subjects is the same in these groups, they are not the same individual subjects.

References

Frankel, F., Freeman, B., Ritvo, E., Chikami, B. and Carr, E. Effects of frequency on photic stimulation upon autistic and retarded children. American Journal of Mental Deficiency, 1976, 81, 32-40.

Goldfarb, W. An investigation of childhood schizophrenia. Archives of General Psychiatry, 1964, 11, 620-634.

Hale, G. and Morgan, J. Developmental trends in children's component selection.

Hermelin, B. and O'Connor, N. Psychological experiments with autistic children. New York: Pergamon Press, 1970.

Koegel, R.L. and Rincover, A. Some deterimental effects of using extra stimuli to guide learning in normal and autistic children. Journal of Abnormal Child Psychology, 1976, 4, 59-71.

Kovaas, O.I. and Schreibman, L. Stimulus overselectivity of autistic children in a two stimulus situation. Behavior Research and Therapy, 1971, 9, 305-310.

Ornitz, E.M. The modulation of sensory input and motor output in autistic children. Journal of Autism and Childhood Schizophrenia, 1974, 4, 197-216.

Ornitz, E.M. and Ritvo, E.R. Perceptual inconstancy in early infantile autism. Archives of General Psychiatry, 1968, 18, 79-98.

Schopler, E. Visual versus tactual receptor preferences in normal and schizophrenic children. Journal of Autism and Childhood Schizophrenia, 1966, 71, 108-114.